

BTS7205H 2.3 GHz – 2.7 GHz RX Analog Front-End IC with bypass Rev. 9 – 12 October 2021 Product data sheet

1 General description

The BTS7205H is a dual channel Receiver Analog Front-End module (RX AFE) available in a leadframe HVQFN package.

The BTS7205H is designed for 5G mMIMO Infrastructure applications. The BTS7205H includes 2 independent receive channels with a low noise amplifier (LNA) with variable gain control. Each channel also has a switch for high-power TX signals. In addition, each channel has a separate TX signal bypass to RX output via a coupler.

The device is matched to 50 Ω and integrates harmonic and out-of-band filtering which minimizes the layout area in the application.

2 Features and benefits

- Operating frequency range 2.3 GHz 2.7 GHz
- 150 mW power dissipation per channel
- RX power gain 37 dB
- RX power gain attenuation step 6 dB
- Typical Noise Figure 1.3 dB
- High TX power handling 37 dBm (9 dB PAPR)
- Single-ended input /output RF ports matched to 50 Ω
- · Fast switching time between operation modes
- TX signal bypass via coupler to RX output
- · ESD protection on all pins
- Leadframe HVQFN package 5.0 mm x 5.0 mm x 0.85 mm with 32 pins

3 Applications

- 5G mMIMO
- Wireless Infrastructure



4 Quick reference data

Table 1. Quick reference data

f = 2.5 GHz; V_{CC} = 3.3 V, T_{case} = 50 °C; input and output 50 Ω ; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Тур	Мах	Unit
High gai	in RX mode; signal from ANT to I	RX_OUT	1	1		
I _{CC}	supply current		-	46	51	mA
G _p	power gain		35	36.7	38	dB
NF	noise figure		-	1.3	1.4	dB
IP3 _o	output third-order intercept point	2-tones at 10 MHz distance, P _i = -40 dBm each tone	22.5	25	-	dBm
P _{i(1dB)}	input power at 1 dB gain compression		-25	-23	-	dBm
Low gai	n RX mode; signal from ANT to F	x_out	1	I		
I _{CC}	supply current		-	46	51	mA
G _p	power gain		29	31.2	32.5	dB
α _{step}	attenuation step		5.2	5.5	6.3	dB
NF	noise figure		-	1.5	1.7	dB
IP3 _o	output third-order intercept point	2-tones at 10 MHz distance, P _i = -40 dBm each tone	22	24	-	dBm
P _{i(1dB)}	input power at 1 dB gain compression		-19	-17	-	dBm
TX mode	e; signal from ANT to TERM	·				
I _{CC}	supply current		-	5.9	6.5	mA
P _{i(AV)TX}	maximum average input power in	applied on ANT pin, 10 years, T _{case(AV)} = 99 °C ^[2]	34	-	-	dBm
	TX mode ^[1]	applied on ANT pin, 10 seconds, T_{case} = 105 °C ^[3]	37	-	-	dBm
TX bypa	ss mode: Signal from ANT to RX	_OUT via coupler	1	1		
G _p	power gain		-31.5	-31	-30.5	dB

[1] CP-OFDM with 9 dB PAPR, BW = 100 MHz, QPSK modulated, SCS = 60 kHz, fully allocated

[2] T_{case(AV)} is an equivalent temperature that yields the same aging over life time as the expected temperature profile which includes temperatures up to 105 °C

[3] See <u>Table 7</u>

5 Ordering information

Table 2.

Type number Orderable part Package Name		Package				
		Name	Description	Version		
BTS7205H	BTS7205HHP	HVQFN32	Plastic thermal enhanced very thin quad flat package; no leads; 32 terminals; body 5.0 mm x 5.0 mm x 0.85 mm	SOT617-3		

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6 Marking

Table 3.					
Type number	Marking code				
BTS7205H	7205H				

7 Functional diagram



8 Pinning information

8.1 Pin diagram



8.2 Pin description

Table 4.

Pin	Symbol	Description
1	D0-CHA	Select attenuation for channel A
2	BP-CHA	Bypass switch control for channel A
3	T/R-CHA	Select RX mode / TX mode for channel A
4, 5, 9,11, 13, 15, 17,19, 20, 21, 22, 24, 26, 28, 30, and 32	GND	Ground reference
6	T/R-CHB	Select RX mode / TX mode for channel B
7	BP-CHB	Bypass switch control for channel B
8	D0-CHB	Select attenuation for channel B
10	RX_OUT-CHB	RF output for channel B (50 Ω , single ended)
12, 14	V _{CC} -CHB	Supply voltage for channel B
16	TERM-CHB	Termination RF output for channel B (50 Ω , single ended, DC at 0 V)
18	ANT-CHB	RF input for channel B (50 Ω , single ended, DC at 0 V)
23	ANT-CHA	RF input for channel A (50 Ω , single ended, DC at 0 V)
25	TERM-CHA	Termination RF output for channel A (50 $\Omega,$ single ended, DC at 0 V)
27, 29	V _{CC} -CHA	Supply voltage for channel A
31	RX_OUT-CHA	RF output for channel A (50 Ω , single ended)
Die paddle	GND	Ground reference

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9 Functional description

9.1 Modes of operation

T/R-CHA	BP-CHA	D0-CHA	Mode of Operation
Low	Low/High	Low	RX High gain mode for channel A
Low	Low/High	High	RX 6 dB reduced-gain mode for channel A
High	Low	Low/High	TX mode for channel A
High	High	Low/High	TX with bypass mode for channel A

Table 6. Modes of operation for channel B

T/R-CHB	BP-CHB	D0-CHB	Mode of Operation
Low	Low/High	Low	RX High gain mode for channel B
Low	Low/High	High	RX 6 dB reduced-gain mode for channel B
High	Low	Low/High	TX mode for channel B
High	High	Low/High	TX with bypass mode for channel B

10 Limiting values

Table 7.

In accordance with the Absolute Maximum Rating System (IEC 60134)

Symbol	Parameter	Conditions	Min	Мах	Unit
V _{CC}	supply voltage		-0.3	6	V
VDC _(ctrl_pins)	DC voltage on control pins	applied on control pins D0, BP, and T/R	-0.3	3.45	V
VDC _(RF_pins)	DC voltage on RF pins	applied on both ANT, and both TERM, RF pins	0	0	V
P _{i(AV)RX}	average input power in RX mode ^[1]	applied on ANT pin, 24 hours, T _{case} = 105 °C	-	11	dBm
P _{i(AV)TX}	average input power in TX mode ^[1]	applied on ANT pin, 10 seconds, T _{case} = 105 °C	-	39	dBm
T _{stg}	storage temperature		-40	150	°C
Tj	junction temperature		-	150	°C
V _{ESD}	electrostatic discharge voltage	Human Body Model (HBM) according to ANSI/ESDA/JEDEC standard JS-001	-2	2	kV
		Charged Device Model (CDM) according to ANSI/ESDA/JEDEC standard JS-002	-500	500	V

[1] CP-OFDM with 9 dB PAPR, BW = 100 MHz, QPSK modulated, SCS = 60 kHz, fully allocated

11 Recommended operating conditions

Table 8.

Symbol	Parameter	Conditions		Min	Тур	Max	Unit
f _{oper}	operating frequency			2.3	-	2.7	GHz
Z ₀	characteristic impedance			-	50	-	Ω
V _{CC}	supply voltage	on pins V_{CC1} , and V_{CC2}	[1]	3.15	3.3	3.45	V
VIH	HIGH-level input voltage	at pins D0, BP, and T/R		1.2	1.8	2.5	V
V _{IL}	LOW-level input voltage	at pins D0, BP, and T/R		0	-	0.6	V
T _{case}	case temperature	exposed die paddle at package bottom		-40	50	105	°C

[1] channel A and channel B can be used independently

12 Thermal characteristics

Table 9.

Symbol	Parameter	Conditions	Min	Тур	Max	Unit
R _{th(j-case)}	channel-junction to case thermal	TX mode	-	49	-	K/W
	resistance	RX mode	-	55	-	K/W

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13 Characteristics

Table 10.

f = 2.5 GHz; $V_{CC} = 3.3 \text{ V}$, $T_{case} = 50 \text{ }^{\circ}\text{C}$; input and output 50 Ω ; unless otherwise specified. Characteristics apply to each channel A and B separately.

Symbol	Parameter	Conditions	Min	Тур	Мах	Unit
High gain R)	K mode; signal from ANT to RX_O	UT				
I _{cc}	supply current		-	46	51	mA
G _p	power gain		35	36.7	38	dB
		f = 2.3 GHz to 2.7 GHz, T_{case} = -40 °C to 105 °C	34	-	40	dB
G _{flat}	gain flatness	in 200 MHz band	-	0.25	0.8	dB
NF	noise figure		-	1.3	1.4	dB
		f = 2.3 GHz to 2.7 GHz, T_{case} = -40 °C to 105 °C	-	-	1.7	dB
RLi	input return loss	f = 2.3 GHz to 2.7 GHz	16	20	-	dB
RLo	output return loss	f = 2.3 GHz to 2.7 GHz	13	16	-	dB
RL _{align(RX-TX)}	return loss alignment RX-TX	R_{TERM} = 50 Ω , f = 2.3 GHz to 2.7 GHz	15	-	-	dB
$\alpha_{isol(ch-ch)}$	isolation channel to channel	f = 2.3 GHz to 2.7 GHz [1]	42	45	-	dB
G _{rel(f2/f0)}	relative gain (G _{f2} /G _{f0})	$f_0 = 2.3 \text{ GHz}$ to 2.7 GHz, $f_2 = 2 \times f_0$	-	-39	-25	dB
G _{rel(f3/f0)}	relative gain (G _{f3} /G _{f0})	$f_0 = 2.3 \text{ GHz}$ to 2.7 GHz, $f_3 = 3 \times f_0$	-	-44	-43	dB
α _{2Ho}	output second harmonic level	P _o = 0 dBm	-	-50	-47	dBm
α _{3Ho}	output third harmonic level	P _o = 0 dBm -		-74	-70	dBm
IP3 _o	output third-order intercept point	2-tones at 10 MHz distance, $P_i = -40 \text{ dBm}$ each tone	22.5	25	-	dBm
		2-tones at 10 MHz distance, P_i = -40 dBm each tone, f = 2.3 GHz to 2.7 GHz, T_{case} = -40 °C to 105 °C	21	-	-	dBm
P _{i(1dB)}	input power at 1 dB gain compression		-25	-23	-	dBm
К	stability factor	1 MHz to 20 GHz, T_{case} = -40 °C to 105 °C	1	-	-	-
Low gain RX	(mode; signal from ANT to RX_O	UT				
I _{cc}	supply current		-	46	51	mA
G _p	power gain		29	31.2	32.5	dB
		f = 2.3 GHz to 2.7 GHz, T_{case} = -40 °C to 105 °C	28	-	34	dB
α _{step}	attenuation step		5.2	5.5	6.3	dB
G _{flat}	gain flatness	in 200 MHz band	-	0.25	0.8	dB
NF	noise figure		-	1.5	1.7	dB
		f = 2.3 GHz to 2.7 GHz, T_{case} = -40 °C to 105 °C	-	-	2	dB
RLi	input return loss	f = 2.3 GHz to 2.7 GHz	16	20	-	dB
RL _o	output return loss	f = 2.3 GHz to 2.7 GHz	13	16	-	dB
RL _{align(RX-TX)}	return loss alignment RX-TX	R_{TERM} = 50 Ω , f = 2.3 GHz to 2.7 GHz	15	-	-	dB

Table 10. ...continued

f = 2.5 GHz; V_{CC} = 3.3 V, T_{case} = 50 °C; input and output 50 Ω ; unless otherwise specified. Characteristics apply to each channel A and B separately.

Symbol	Parameter	Conditions	Min	Тур	Мах	Unit
$\alpha_{isol(ch-ch)}$	isolation channel to channel	f = 2.3 GHz to 2.7 GHz [1]	45	47	-	dB
G _{rel(f2/f0)}	relative gain (G _{f2} /G _{f0})	$f_0 = 2.3 \text{ GHz to } 2.7 \text{ GHz}, f_2 = 2 \text{ x } f_0$		-37	-25	dB
G _{rel(f3/f0)}	relative gain (G _{f3} /G _{f0})	$f_0 = 2.3 \text{ GHz to } 2.7 \text{ GHz}, f_3 = 3 \times f_0$	-	-46	-44	dB
α _{2Ho}	output second harmonic level	P _o = 0 dBm	-	-51	-48	dBm
α _{3Ho}	output third harmonic level	P _o = 0 dBm	-	-72	-68	dBm
IP3 _o	output third-order intercept point	2-tones at 10 MHz distance, P _i = -40 dBm each tone	22	24	-	dBm
		2-tones at 10 MHz distance, P _i = -40 dBm each tone, f = 2.3 GHz to 2.7 GHz, T _{case} = -40 °C to 105 °C	21	-	-	dBm
P _{i(1dB)}	input power at 1 dB gain compression		-19	-17	-	dBm
К	stability factor	1 MHz to 20 GHz, T _{case} = -40 °C to 105 °C	1	-	-	-
TX mode; si	gnal from ANT to TERM					,
I _{cc}	supply current		-	5.9	6.5	mA
IL	insertion loss	from ANT to TERM	-	0.55	0.6	dB
RLi	input return loss	f = 2.3 GHz to 2.7 GHz	19	23	-	dB
RL _o	output return loss	f = 2.3 GHz to 2.7 GHz	17.5	20	-	dB
α _{isol(ANT-RX)}	isolation between ANT to RX_OUT	f = 2.3 GHz to 2.7 GHz	55	-	-	dB
P _{i(AV)TX}	Maximum average input power in TX mode ^[2]	applied on ANT pin, lifetime (10 yrs), ^[3] T _{case(AV)} = 99 °C	34	-	-	dBm
TX bypass n	node: Signal from ANT to RX_OUT	via coupler				
I _{CC}	supply current		-	6.2	6.5	mA
G _p	power gain		-31.5	-31	-30.5	dB
RLi	input return loss	f = 2.3 GHz to 2.7 GHz	19	23	-	dB
RLo	output return loss	f = 2.3 GHz to 2.7 GHz	16	19	-	dB
Switching b	etween modes					
$t_{sw(\alpha)RX}$	switching time RX attenuation		-	-	85	ns
t _{sw(RX-TX)}	switching from RX to TX	for the power transient at RX_OUT -		-	100	ns
t _{sw(TX-RX)}	switching from TX to RX		-	-	1	μs
t _{sw(TX-bypass)}	switching to TX bypass		-	-	1	μs

[1]

 G_p [ANT-CHA, RX_OUT-CHA] / G_p [ANT-CHB, RX_OUT-CHA] CP-OFDM with 9 dB PAPR, BW = 100 MHz, QPSK modulated, SCS = 60 kHz, fully allocated $T_{case(AV)}$ is an equivalent temperature that yields the same aging over life time as the expected temperature profile which includes temperatures up to 105 °C [2] [3]

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14 Graphs

14.1 All modes



14.2 High gain RX mode



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14.3 Low gain RX mode



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14.4 TX mode



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14.5 TX bypass mode



15 Application information



Table 11. Application schematic

Table 12. List of components

Component	Description	Value	amount	Remarks
R1, and R2	load resistor	50 Ω, 50 W	2	must be able to withstand 34 dBm average power over lifetime
C11, C12, C21, and C22	capacitor	10 nF	4	as close as possible, less than 10 mm from IC
C13, C14, C23, and C24	capacitor	1 µF	4	as close as possible, less than 10 mm from IC
L1, and L2	inductor	19 nH	2	high-Q inductor, close to IC

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16 Package outline



Product data sheet

16.1 Footprint and solder information

NXP recommends by default to apply the soldering and footprint guidelines as are released in POD SOT617-3.



17 Handling information



This device is sensitive to ElectroStatic Discharge (ESD). Observe precautions for handling electrostatic sensitive devices. Such precautions are described in the *ANSI/ESD S20.20, IEC/ST 61340-5, JESD625-A* or equivalent standards.

18 Abbreviations

Table 13.	
Acronym	Description
AMP	amplifier
ANT	antenna
BP	bypass
CPLR	coupler
CP-OFDM	cyclic prefix orthogonal frequency division multiplexing
D0	data line 0
ESD	electrostatic discharge
HVQFN	heat sink very thin quad flat no-leads
LNA	low noise amplifier
mMIMO	massive multiple-input multiple-output
PAPR	peak to average power ratio
QPSK	quadrature phase shift keying
SCS	sub carrier spacing
SPDT	single pull double throw
TERM	termination
T/R	transmit/receive mode

19 Revision history

Table 14.					
Document ID	Release date	Data sheet status	Change notice	Supersedes	
BTS7205H v.9	20211012	Product data sheet	-	BTS7205H v.8	
modification	 added frequen 	 added frequency setting to the G_p condition on both RX gain modes 			
BTS7205H v.8	20211008	Product data sheet	-	BTS7205H v.7	
modification	 changed footnot updated the full	 changed status to Public Product data sheet changed footnote at α_{isol(ch-ch)} for both RX modes updated the functional diagram updated the orderable part number 			
BTS7205H v.7	20210722	Preliminary data sheet	-	BTS7205H v.6.1	

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Document ID	Release date	Data sheet status	Change notice	Supersedes		
modification	 changed graph 	 changed value for Minimum, and Typical on RX_gain High channel to channel isolation changed graphic on RX_gain High channel to channel isolation added value on TX insertion loss to the characteristics table 				
BTS7205H v.6.1	20210625	Preliminary data sheet	-	BTS7205H v.6		
modification	 added P_{i(AV)TX} 	 added P_{i(AV)TX} parameter to the TX Characteristics table 				
BTS7205H v.6	20210615	Preliminary data sheet	-	BTS7205H v.5		
modification	 added Graphic 	added Graphics to the data sheet				
BTS7205H v.5	20210528	Preliminary data sheet	-	BTS7205H v.4		
modification	 split Thermal re added marking	 changed Min, Max values on some parameters split Thermal resistance in a value for TX mode, and a value for RX mode added marking info changed status to Preliminary 				
BTS7205H v.4	20210430	Objective data sheet	-	BTS7205H v.3.1		
modification	 changed Min, N 	changed Min, Max values on some parameters				
BTS7205H v.3.1	20210317	Objective data sheet	-	BTS7205H v.3		
modification		 changed T_{case} from 50 °C to 105 °C for P_{i(AV)RX} at Limiting values added footnote to parameter P_{i(AV)TX} at Limiting values 				
BTS7205H v.3	20210311	Objective data sheet	-	BTS7205H v.2		
modification	 adapted the Mo adapted some	 removed the exception on the ESD conditions on the ANT pins in Limiting values table adapted the Modes of operation tables adapted some characteristics values removed and adapted Switching mode conditions 				
BTS7205H v.2	20210108	Objective data sheet	-	BTS7205H v.1		
modification	 changed Minim 	changed Minimum, Typical, and Maximum values on many parameters				
BTS7205H v.1	20200903	Objective data sheet	-	-		
	l	1	1			

Table 14. ...continued

20 Legal information

20.1 Data sheet status

Document status ^{[1][2]}	Product status ^[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

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